A NOVEL PAPER HAVING LOW LINT AND/OR ANTI-STATIC PROPERTIES

Field of the Invention

A paper having low linting and/or anti-static, static dissipative paper qualities, for use as note paper for use in industries such as the electronic industries printing paper or in the packaging field as a void fill or a flat sheet or a pleated wrap, or for use in the packaging of electronic components.

SUMMARY OF THE INVENTION

A formable low linting, anti-static/static dissipative paper is designed for such uses as a note paper or as a void fill or in packaging of particulate sensitive and/or static sensitive products or printing paper. The paper is designed for converting in such equipment as pleating or other machines that bulk the paper to increase its void fill propensity. The process substantially increases the paper's void fill capability. The paper can be molded, as for example in a generally spherical form, pyramidal, oval or other half shell form. Preferably, the two halves are glued together to form a hollow, high bulk, low weight structure. In other applications, the paper is employed for a writing or printing, or can be provided with a releasable adhesive for use in a notepaper pad,

In the manufacturing process an aqueous solution consisting of a binder, blended with a solution of antistatic material, hereinafter referred to as a "saturant", is applied to a base paper. Preferably, the saturant is applied to a web of partially dried base paper during the paper making process. Alternatively, the saturant can be applied when the paper is in the form of a slurry or post-manufacture of the base paper.

The properties of the base paper being such that the deposition of the saturant renders the paper anti-static/static dissipative, low linting and pleatable, moldable and/or formable. The saturant treated product is subsequently dried to a prescribed moisture level.

In a second embodiment, the saturant is applied to a dried base paper such that the deposition of the saturant renders the paper anti-static/static dissipative, low linting and pleatable. The saturant treated product is subsequently dried to a prescribed moisture level.

The final product can be in a roll, or in a stack of aligned sheets, each sheet including a static dissipative agent. Each sheet has an observe side that serves as a writing surface and an obverse side. In a note pad embodiment, each reverse side includes a coating of pressure sensitive repositionable adhesive by which the sheet is adhered to the sheet beneath it in the stack. The coating extends along and within relatively narrow band. The obverse side can include release means providing a reliable first adhesion zone between adjacent sheets in the stack and adjacent one of the edges of the sheet for providing a sufficiently low release force between the adhesive coating and the upper surface of the adjacent sheet in the stack. The adhesive coating can include a static dissipative agent and each sheet includes a static dissipative agent.

In another embodiment, the conductive materials are blended into the pulp slurry prior to formation of the paper web. In this instance, the anti-static/static dissipative properties are achieved through the benefit of the conductive materials embedded in the paper during its formation. The paper can be molded from the slurry form, or post treated to achieve a desired self-supporting shape.

In a further embodiment, the paper is a low extractable, low particulating, anti-static/static dissipative paper, suitable for use in clean room environments and in other

applications which are sensitive to corrosive, particulate and electrostatic contamination. In this embodiment the selection of the components of the saturant is predicated by the end use requirements that the product meet stringent extractable levels (i.e. low levels of corrosive elements including but not limited to chloride, potassium, carbon, Sodium, and sulfur. Low particulating properties are such that its capacity for particulate generation, is at a level of less than 1000 particles, <0.5 microns, per ft^3, when measured in a Helmke Drum, a device well known in the cleanroom industry.

The method of making the anti-static paper, includes the steps of:

forming a partially dried fibrous base paper,

treating said partially dried fibrous base paper with a saturant,

said saturant comprising a solution of an anti-static agent, and a liquid carrier,

depositing said anti-static agent in the interstices of said fibrous base paper,

and drying said treated base paper to a predetermined moisture level.

The resultant anti-static paper is advantageously, low linting, and static dissipative, in a range of approximately $1x10^3$ ohms per square to 1×10^{11} ohms per square, at a relative humidity of no greater than 15%.

Advantageously, the saturant includes viscosity increasing agent, having a viscosity in the range that suppresses saturation of said base paper while not substantially suppressing delivering of said anti-static agent to the interstices of said fibrous base paper. Preferably the anti-static agent is selected from the group consisting of electro-conductive quaternary ammonium polymer and salts thereof. The agent can be other know dissipation agents such as aluminum sulfate, carbon, poly(3,4-ethylenedioxythiophene)/poly(styrenesulfonate) and poly-aluminum chloride. Advantageously, the saturant is a pre-blended solution of

conductive resin and starch at a total solids of greater than about than 10% dry solids, and preferably is formulated to a ratio >15% conductive material (dry weight) and <85% modified starch (dry weight).

The penetration of the saturant into said base paper is facilitated by incorporating an internal sizing, in the range from 0.5 to 30 lbs of sizing per ton of base paper. The penetration deposits the static dissipative agent in the interstices of said fibrous base paper.

Preferably, the paper is low linting for use in such applications as clean rooms, and has an ash content of less than 15% by weight.

The paper can be formed into a non-planar void fill material, having, for example, a concave shape, preferably, a shape that is non-uniform and thereby non-nesting. Among the preferred shapes, are elliptical, curvilinear, oval, and ovoid configurations.

In another embodiment, the non-planar void fill material has alternate concave and convex rows that are in the form of corrugations or pleats.

In a further application, two concave units are combined into a hollow single unit for use as a void fill.

The paper, advantageously, can be used as a pad assembly. The pad is a multiplicity of flexible sheets, each sheet being generally of the same size, having obverse and rear surfaces, having electrostatic dissipative paper having peripheral edges including first and second opposite edges, having a band of repositionable pressure sensitive adhesive coated on said rear surface adjacent to and spaced by a large predetermined spacing from said second edge. The sheets are disposed in a stack with the corresponding peripheral edges of the sheets aligned, the front and rear surfaces of adjacent sheets facing each other, and the band of repositionable pressure sensitive adhesive on each sheet adhering that sheet to the adjacent

sheet in the stack Preferably, the adhesive includes an electrostatic dissipative agent.

DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

The product is a low linting, anti-static or static dissipative paper. It can be pleated, corrugated, molded, and/or formed in a desired shape for use as a void fill in the packaging of particulate sensitive and/or static sensitive products. It can be used as a packaging wrap and preferably, in a pleated or other shaped form, in order to enhance its performance as a packaging wrap. Additionally, it can be used as a printing paper.

The base paper consists of a blend of wood fibers, such as, softwood kraft, hardwood kraft, recycled paper and synthetic fibers, and/or combinations thereof. Base papers are well known in the paper industry.

During the manufacturing process, an aqueous solution, hereinafter referred to as the "saturant", is applied to the partially dried base paper.

The properties of the base paper are such that the deposition of the saturant renders the paper low linting, pleatable and antistatic, preferably, in a range of approximately $1x10^3$ ohms per square to 1×10^{11} ohms per square, at a relative humidity of no greater than 15% and a maximum voltage decay rate of approximately two seconds at less than 15% relative humidity for ~ 5,000 applied volts to technical zero volts, upon grounding of the product.

The properties include:

Base paper composition: including but not limited to softwood kraft, hardwood kraft, recycled paper, and synthetic fibers. The synthetic fibers can include a variety of synthetic fibers typically used in the manufacture of paper (i.e. Rayon, polyester, glass etc.) as well as

synthetic fibers less typically used (i.e. carbon fibers). Other synthetic fibers can be used as well, to improve either the physical and/or the electrical properties of the paper.

Base paper additives: including but not limited to inorganic and organic fillers and chemicals in ratios to achieve the desired base sheet properties and to facilitate penetration of the saturant. Synthetic fillers used can include, but is not limited to a variety of inorganic fillers typically used in paper manufacturing (i.e. clays, TiO_2, aluminum trihydrate etc.). Additionally, organic fillers (i.e. carbon black, iron oxides etc.), though less typically used in paper manufacturing, can be used to improve the physical and/or electrical properties of the paper.

Chemical additives: including but not limited to additives that can improve the physical and/or electrical properties. These chemicals can include, but are not limited to, electro-conductive quaternary ammonium polymer and/or other inorganic salts, aluminum sulfate, poly-aluminum chloride, poly(3,4-ethylenedioxythiophene)/poly(styrenesulfonate) also known as PEDT/PSS, or other chemicals that can enhance the physical and/or electrical properties of the finished paper.

Porosity, as measured on a Gurley densitometer, an instrument well known in the paper industry, is controlled to achieve a porous substrate to facilitate penetration of the saturant. The penetration of the saturant can impact the desired properties of the finished product. The porosity level of the base paper is controlled during the stock preparation, forming, and pressing of the base paper fibers during production. The porosity level of the base paper is controlled to a value of < 5-sec./100 ml as measured on the Gurley densitometer.

Internal sizing, also referred to as water resistance, as measured by a plurality of methods well known in the paper industry. The sizing is controlled to within a range of 0.5 lbs/ton to 30 lbs/ton as required to affect the absorptive properties of the substrate to facilitate penetration of the saturant and thereby impact the desired properties of the finished product. The internal sizing is controlled through the addition and control of chemical additives that are added to impact the water resistance of the finished paper. An example of these internal sizing additives includes AKD, ASA, and rosin size. Sizing additives are well known in the paper industry.

<u>Ash content</u>: a low ash content, in the range of <15%, reduces the papers tendency to slough particulate matter during the converting and end-use applications. The ash content is controlled through the selection and control of the quality and quantity of recycled as well as inorganic filler materials used in the base paper. The ability to produce a lint free paper is particularly critical for those applications in which the paper is post-treated for use in packaging, writing or printing. In post treatments, such as slitting or forming of the paper or pleating of the paper, the production of lint can be severe. While the lint product is a problem in general, it is a major problem in clean room applications, as for example in the electronics industry, and laboratory applications.

<u>Base Sheet Moisture Content</u>: The base paper moisture content is controlled to a level of approximately 0.5% to 12%, dependant upon desired properties in the finished product. Percent moisture is based on the weight of water relative to the weight of the dry components of the paper.

<u>Saturant</u>: The saturant is a pre-blended solution of conductive resin and starch at a total solids of approximately >10% dry solids. The solids can be adjusted, either by dilution

with the addition of water or enriched by the addition of a higher solids batch, during application, as needed to achieve the desired properties in the finished product. The saturant is formulated to a ratio >15% conductive material (dry weight) and <85% modified starch (dry weight). The conductive material is essentially an electro-conductive quaternary ammonium polymer, and is available commercially from a plurality of specialty chemical manufacturers and suppliers and in a variety of concentrations and refinements. The starch can be either a modified corn and/or a modified potato starch of a low viscosity variety. The low saturant viscosity is of significance due to the fact that penetration onto the base paper impacts the final properties of the finished product as it impacts the deposition of the saturant into the interstices of the base paper. The deposition of the saturant into the base paper impacts several properties of the finished product. The properties impacted include conductivity, pleatability, and linting or particulate sloughing.

The saturant treated product is subsequently dried to a prescribed moisture level of in the range of approximately 3.5% to 6.5%.

In another embodiment, a formable, as for example, pleatable low linting, anti-static/static dissipative paper is preferably formed from a base paper having a porosity level that is maintained, preferably, at a level of at least about >25 sec./100 ml as measured on the Gurley densitometer.

A low linting, anti-static/static dissipative paper preferably has a basis weight is in the range from about 8 gsm (grams per sq meter) to 300 gsm, and preferably in the range from about 8 to about 200 gsm.

The fiber furnish is primarily bleached kraft or natural kraft.

In another embodiment, the fiber furnish is primarily recycled fiber.

Preferably, the conductive material portion of the saturant is a combination of electro-conductive quaternary ammonium polymer and/or other inorganic salts, metal oxides, or carbon based conductive materials or fibers. The paper has particular utility as a notepaper, of the type sold under the registered trademark Post-it, by 3M corporation. The paper 102 can be in the form of a pad, indicated generally as 100, and having a plurality of sheets 106. Pressure sensitive adhesives for releasable or repositionable note paper are well know in the art, and background information can be found in such U.S. Patents, as 4,460,634, 3,857,731, 5,641,550, 5,382,055 and 5,153,041. It has now been found that a new product can be formed by using the above described static dissipative formulation to produce the paper. The paper can have a release coating on its obverse side, that is, the writing surface of the paper. The adhesive 104 is applied to the reverse side, preferably along a narrow region.

Preferably, the adhesive is provided with a static dissipative agent as described above. The static dissipative additive adhesive can dissipate static charges even when in an admixture with an adhesive. Thus, static charge accumulating materials such as accumulated dust, dirt and the like, will not negate the dissipative properties of the ESD paper.

In another embodiment, static dissipative agents that are able to migrate from the paper to the adhesive can be used.

In a further embodiment, the static dissipative agent in the paper is sufficient to dissipate static charges that would otherwise accumulate in the impurities that adhere to the adhesive.

Starch or an equivalent additive is employed to prevent the anti-static paper from sticking to rollers during processing.

The sizing controls amount of saturant that saturates the base paper. Completely saturating the paper without sizing is highly disadvantageous. The viscosity range is 20 to 200 cps at 100 F Brookfield viscometer and preferably less than 100 cps.

The conductive materials can be blended into the pulp slurry prior to formation of the paper web. In this instance, the anti-static/static dissipative properties are achieved through the benefit of the conductive materials embedded in the paper during its formation. The paper can be molded from the slurry form, or post treated to achieve a desired self-supporting shape.

The paper can also be formed as a low extractable, low particulating, anti-static/static dissipative paper, suitable for use in clean room environments and in other applications which are sensitive to corrosive, particulate and electrostatic contamination. In this embodiment the selection of the components of the saturant is predicated by the end use requirements such that the product meet stringent extractable levels (i.e. low levels of corrosive elements including but not limited to chloride, potassium, carbon, sodium, and sulfur), low particulating properties (such that its capacity for particulate generation, is at a level of less than 1000 particles, <0.5 microns, per ft^3, when measured in a Helmke Drum, a device well known in the clean room industry). A latex paper coating is employed to reduce particle extraction and is particularly preferred for use in clean room applications.

In this embodiment, it is preferred that the saturant's binder be comprised of a synthetic binder dispersion, the polymer of which has a glass transition temperature (TG) of less than approximately 30 degrees C. Such materials can include natural or synthetic latex, styrenes, acrylics, and polyurethanes.

The term "anti-static" as employed herein, means preventing or inhibiting the buildup of static electricity. As used, it is inclusive of the term "dissipative" as applied to paper and is used interchangeably with "dissipative".

The term dissipate, is used in accordance with the following definition: To drive away; disperse. **2.** To attenuate to or almost to the point of disappearing. To use up, especially recklessly; exhaust. To cause to lose (energy, such as heat) irreversibly. To vanish by dispersion.